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ABSTRACT

Operation SMART (Science, Math and Relevant Technology) is a project of the Girls Clubs of America, a national organization serving mostly low-income girls in local club centers. Girls clubs provide out-of-school programming that pays special attention to the needs of girls and helps them take charge of their futures. Operation SMART's hands-on science activities and visits to role models in science are accompanied by reflection about science, societal issues, and personal attitudes. This document describes the goals and programs of this operation including the background of the project, and the impact that can be made on the attitudes of girls regarding science and technology. Discussed in this paper are the design of the Operation SMART model, the research on which the program is based, the arrangement of age groups in the program, and the training of staff members. A list of 31 references is included. (CW)

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Operation SMART: From Research to Program -- and Back

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Summary

Operation SMART--"Science, Math, and Relevant Technology"--is a major initiative of Girls Clubs of America, Inc. (GCA), a national organization with 240 Club centers across the United States. Its purpose is to encourage girls to participate in math and science during their school years and as they plan careers. In partnership with GCA, seven local Girls Clubs in Massachusetts and New York are designing model programs of informal education for use by Girls Clubs and other youth serving organizations.

The first Girls Clubs were formed over one hundred years ago during the Industrial Revolution for the young women who worked in the factories of the northeast mill towns, and for the daughters of the factory workers. A century later, Operation SMART is GCA's response to the technological revolution, to women's changing role in the labor market, and to the needs of the 250,000 girls we serve each year. Nearly two-thirds of participating girls are from families with incomes under $15,000, and close to half are members of minority groups. They face an educational and employment system that presents often overwhelming barriers to access and opportunity.

The Operation SMART program was designed after an extensive review of the research. Ongoing program development makes constant reference to the latest findings about strategies for involving girls--especially those from minority and low-income backgrounds. Operation SMART has been effective in large part because the research guided us to successful interventions. (Beane, 1985; Casserly, 1983; The Computing Teacher, 1984; Kahle, 1984; Lockheed and Harris, 1982; Lockheed, 1985; Malcom et al, 1984; Matthews, 1983.)

The cycle that began with our review of the research continues. The questions the project generates are as important as the solutions and approaches we develop. Issues and dilemmas raised during the project's first year--such as how different from school should SMART be, how can fun experiences in the Club carry over to girls' decisions about education and careers, and what encourages innovation and improvement in math and science education--led to the initiation of the Operation SMART research project. Through telephone interviews, case studies, and a conference of "experts," we concluded that, above all else, we must to find ways to e girls a coherent message that math and science are for them. The second phase of the research will take an intensive look at girls in Operation SMART, examining the messages they get at the Club, at home, in school, in outside activities, and from the local and national media. We will also develop a "tool kit" of research and evaluation measures--brief, fun, challenging activities that

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engage girls in measuring their own and each others' attitudes and participation in math, science, and technology.

The Operation SMART Model and the Research On Which It Is Based

The goal of Operation SMART is to help girls acquire an attitude of scientific inquiry toward everything they do. Operation SMART challenges girls to question, observe, record, watch for changes, estimate, make mistakes, try again, take physical and intellectual risks, get messy, take things apart, dissect, analyze, organize, look for patterns--and most important, to be skeptics and not take anything for granted.

The Operation SMART model has "six easy pieces," including scientific inquiry, an approach that pervades the entire program; scheduled sessions in science, math, and technology for small groups of girls, held once or twice a week for an hour or more; incorporation of math and science and an attitude of scientific inquiry in all Club activities and policies; career exploration; family involvement; and community connections, to increase girls' access to resources, and to help in program development.

Each of these components has a strong research or experiential base that constantly informs program development. For example, we focused on scientific inquiry as we reviewed the literature about sex-role stereotyping and girls' access to math and science programs. We considered how social norms shape expectations for girls, and how girls get less exposure to scientific equipment and to the spatial and risk-taking play experiences that help boys to feel comfortable in math and science. (Fennema, 1977; Fennema and Sherman, 1977; Haertel et al, 1981; Miura and Hess, 1983; Lever, 1976; Reid and Stephens, 1985.)

We thought about the qualities of a scientist, such as the ability to generate questions, to concentrate on one's work and ignore outside distractions, to wrestle with uncertainty and tolerate creative chaos, to experiment and analyze both failures and successes, to have the courage to try new and alternative approaches. And we posited that girls' socialization in this culture, where girls and women are valued for being neat and pleasing others, not making mistakes, responding to others' needs before their own, and subordinating or postponing personal goals, inhibits the development of the qualities that promote scientific pursuit. Our answer to the limiting social factors was scientific inquiry, an approach that encourages questioning, exploration, discovery, and taking risks.

We set aside time for girls to try out science and math in new ways during the scheduled sessions held regularly at each of the model Clubs. We encouraged all Club staff to incorporate scientific inquiry and a questioning approach into the programs they conduct with girls. We also focused on the norms and policies of the Club: are girls rewarded for appearance, for being quiet and obedient? What if they are completely engaged in observing the ant farm, or building in the shop? How do adults respond?

We drew on the work of EQUALS and Children's Television Workshop, among others, and emphasized hands-on, fun, and purposeful activity that played down competition and played up cooperation and group problem-solving. We

stressed the use of tools and equipment, physical experience, and process over product.

On a typical afternoon or evening, SMART girls might take apart machines, examine everything from sand to pennies to fingerprints under microscopes, look through telescopes, dissect abandoned birds nests, build replicas of their Club and their towns, dig up earthworms, open up computers and photocopy machines to see how they work, use tools to fix their bicycles and figure out what makes the wheels go round and the gears operate, experiment with ice and insulation, build their own cameras, use video equipment, or take a simulated canoe trip on the computer.

Offering girls fun and educational experiences in math and science is clearly a centerpiece of Operation SMART, but deals only with the present. Decisions made during a few short years of adolescence have distressingly long-term economic implications for girls' futures (Coalition on Women and the Budget, 1983; National Commission on Working Women; Tittle, 1981; Shapiro and Crowley, 1982). We know that math and science serve as a "critical filter," (Beane, 1985; Peng et al, 1981; Sells, 1973), and that girls who do not pursue these courses eliminate a whole range of career opportunities, especially jobs that are nontraditional, better-paying, and offer the possibility of advancement. The focus of Operation SMART has to be on helping girls keep their career and educational options open.

How can you persuade girls to enroll in math and science courses in school -- courses that may well be boring in a sexist atmosphere that makes them feel uncomfortable? How can you overcome the stereotypes that girls bring with them about what are or are not appropriate roles for women? How do you get girls to imagine the future--their futures--and envision possibilities when they have no experience on which to draw?

Visits to workplaces, contact with role models and mentors, and information about careers (including those that do not require a college degree) are an integral part of the program. "Expanding Your Horizons" Conferences, based on the Math/Science Network model, will be offered in all seven SMART communities this year. But the key to the career component is to raise expectations of what girls can become. We don't accept self-fulfilling and limiting prophecies ("Our girls won't go to college") as justification for tracking girls away from the academic grounding they need for many jobs.

<u>Our Experience in SMART by Age Group</u>

We started by working with the 6- to 11-year-olds, the youngest age group served officially by Girls Clubs. (Many Clubs run pre-schools and day-care centers as well.) We drew on knowledge of early childhood throughout, however, since we knew that sex role stereotypes and gender expectations begin to develop in infancy and can become entrenched as early as the pre-school years. (Albert and Porter, 1983; Brooks-Gunn and Matthews, 1979; Entwisle and Baker, 1983; Lever, 1976; Nemerowicz, 1979; O'Keefe and Hyde, 1983; Pitcher and Schultz, 1983; Reid, 1982; Siegel, 1973; Whiting, 1983.) Also, pre-school approaches to science focused more on the kinds of experiences we wanted girls to have, experiences that involved their whole bodies and engaged all the senses, used lots of manipulatives, stayed away

from pencil-and-paper except when necessary, focused on building and taking apart, and fostered imagination and creativity.

We had not anticipated that many of the 6- to 8-year-olds had never had the pre-school experiences, had never built with blocks, had never really grasped symbolic representation, and were now, in school, having great difficulty with such concepts as sequencing and number permanence. SMART Coordinators adapted their programs, using tangible objects--sticks, blocks, cutout animals--instead of numbers. They went for the unexpected. One Club did graphing, but not just on paper: ventilation grills and grids of any kind around one Club were transformed into matrices of coordinates.

We were quite successful in the first two years with the elementary school age group. Attendance was good (a key evaluation variable in a voluntary participation program), a core group of committed girls came back again and again, and girls stopped worrying about getting dirty, got beyond their "yuk" reactions, and felt freer to try new things.

A year ago we began programs for young adolescents, and faced a whole new set of problems. Attendance was inconsistent from day to day and week to week, so we designed activities that were not strictly cumulative. To sustain interest, the questions have to come from the girls themselves. This emphasis meshes well with a skill important in science: the ability to formulate a question worth pursuing and follow it through to resolution.

We also try to capitalize on the developing ethical awareness of early adolescents; model Clubs are designing community service projects that have a focus on science or technology. One Club is planning and building a challenge course in the park with the assistance of the Parks Department; another is working on cleaning up a polluted pond; a third is considering a social science project about the demographics of their Club community, a town in which the Puerto Rican minority is facing increasing discrimination in housing; an editorial in the local paper has proposed that no more Puerto Ricans be allowed to move into the town. The membership of the Girls Club is primarily Puerto Rican, and this project would afford girls an opportunity to apply scientific skills to a question that very directly affects their lives.

Counseling girls about course enrollment is another central effort of the early adolescent component. Clubs are collecting data about course offerings and enrollments in their communities, and designing presentations for parents, sessions with girls, and conferences with school personnel to raise awareness about the importance of making choices that keep options open.

Then of course, there is the issue of boys, and a reemergence, in a powerful way, of gender stereotypes and expectations (Hill and Lynch, 1983). In our coed Clubs, we have seen the phenomenon of girls who will no longer play basketball in the gym when the boys are there; they'll only watch. Or there is the example of Janie, who had been a confident leader among the SMART girls just months earlier, who feigns incompetence: sitting next to her boyfriend, she draws a rocket. Her boyfriend draws a rocket, copying Janie's but less skillfully. Janie crumples hers up and says "yours is great, mine's no good."

But we've seen progress too. Girls were fixing their bikes in the bike repair class being held outside one Club. A group of neighborhood boys walked by, saying "that's not girls' work." An 11-year-old girl retorted, "And who's going to fix my bike when it breaks? It is so girls' work!"

Documentation and evaluation are demonstrating that we are having an impact on the young adolescent age group. At one Club where teenage pregnancy is a major concern, "SMART is now the place to be," and staff are working to make this kind of engagement--in math, science, and technology--compelling enough to replace the anomie that too often leads to early pregnancy and involvement with drugs. Girls who thought a few short months ago that the only jobs they could seek were "secretary," "nurse," and "teacher" are now lining up to become junior explainers at the museum, and thinking about careers they had never imagined, much less considered.

Planning for the high school age component is now underway, with programs for 15- to 18-year-olds scheduled to begin in 1988. Club activities will have a strong career focus, with internship and employment opportunities, scholarships to summer programs at universities, and tutoring and leading of courses for younger girls.

Preparing SMART Staff

One year into the project, we realized that training of staff is a critical need, for a number of reasons. First, the approach of scientific inquiry--of encouraging girls to question rather than giving them answers--does not come easily to most people. Background in math and science does not guarantee that someone will be able to present material in an open-ended fashion. Second, we want all staff to incorporate scientific inquiry into their program approaches, and that means overcoming the resistance that many women--and many Club staff--have toward math and science. Finally, in order for community-based organizations to offer science programs of top quality, Clubs need easy access to technical expertise, information, and resources.

MuseumLink is our answer. This pilot program with the Museum of Science in Boston brings adult Club staff to the museum for training in scientific inquiry and hands-on science, offers technical assistance, and provides answers to such queries as where to buy microscopes or find out more about Bernoulli's principle. More Club/Museum linkages are planned.

Collaboration is Key

Finally, we have found that collaborations--with schools, resource organizations, national and local agencies, professional associations of women in scientific and mathematical fields, other youth-serving agencies, and the media--go a long way toward making change happen. National linkages, of the kind that we have with the Association of Science-Technology Centers (in our MuseumLink project) and the American Association for the Advancement of Science (as one of the community-based organizations to whom they provide help in their Linakges project), have connected Operation SMART to resources and expertise that we could never have tapped alone. These national level connections increase the credibility of SMART at the local Club level; we also have a strong hunch that they will speed up the adoption of SMART by Clubs involved in the replication process.

SMART was not intended to be a substitute for basic education that girls should be receiving in school. But what became clear was that Clubs have the luxury to work with girls in small groups, to identify problems that might be missed in the classroom, and to offer a safe environment for children to admit to difficulties. We are still defining what our role in relation to the schools should be, and how we can act as advocates for improved, non-sexist math and science education.

Ultimately, the more that we can all work together, the more we can help increase the likelihood that girls will get a consistent message about math and science wherever they are, so that they take action and make decisions that allow them to take control of their learning, their lives, and their futures. That will make everyone's world a better place to be.

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